RTB Workshop - Abidjan

Ecological intensification of banana cropping systems

-

Accompanying plants and agro-ecological services

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CIRAD-UR 26

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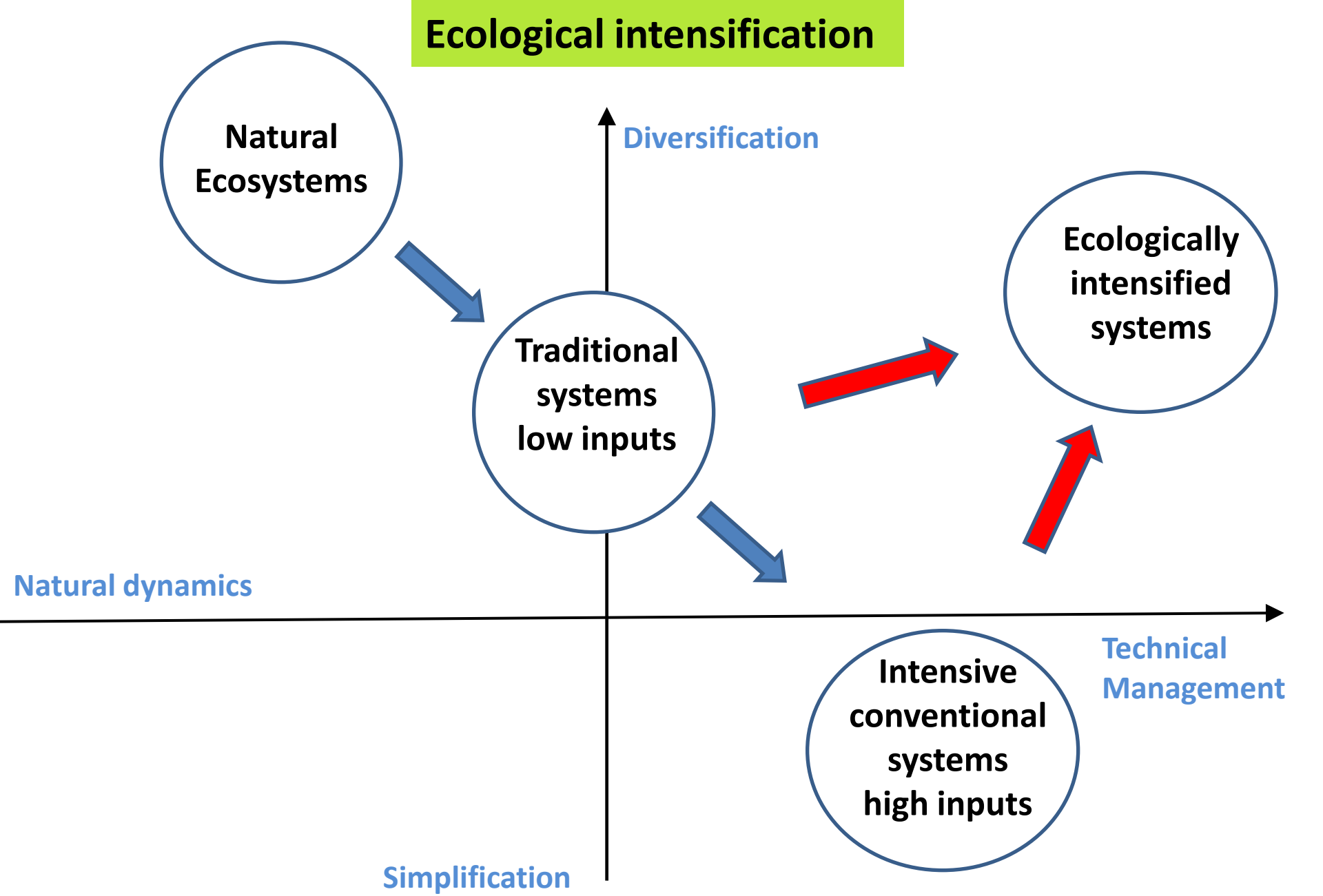
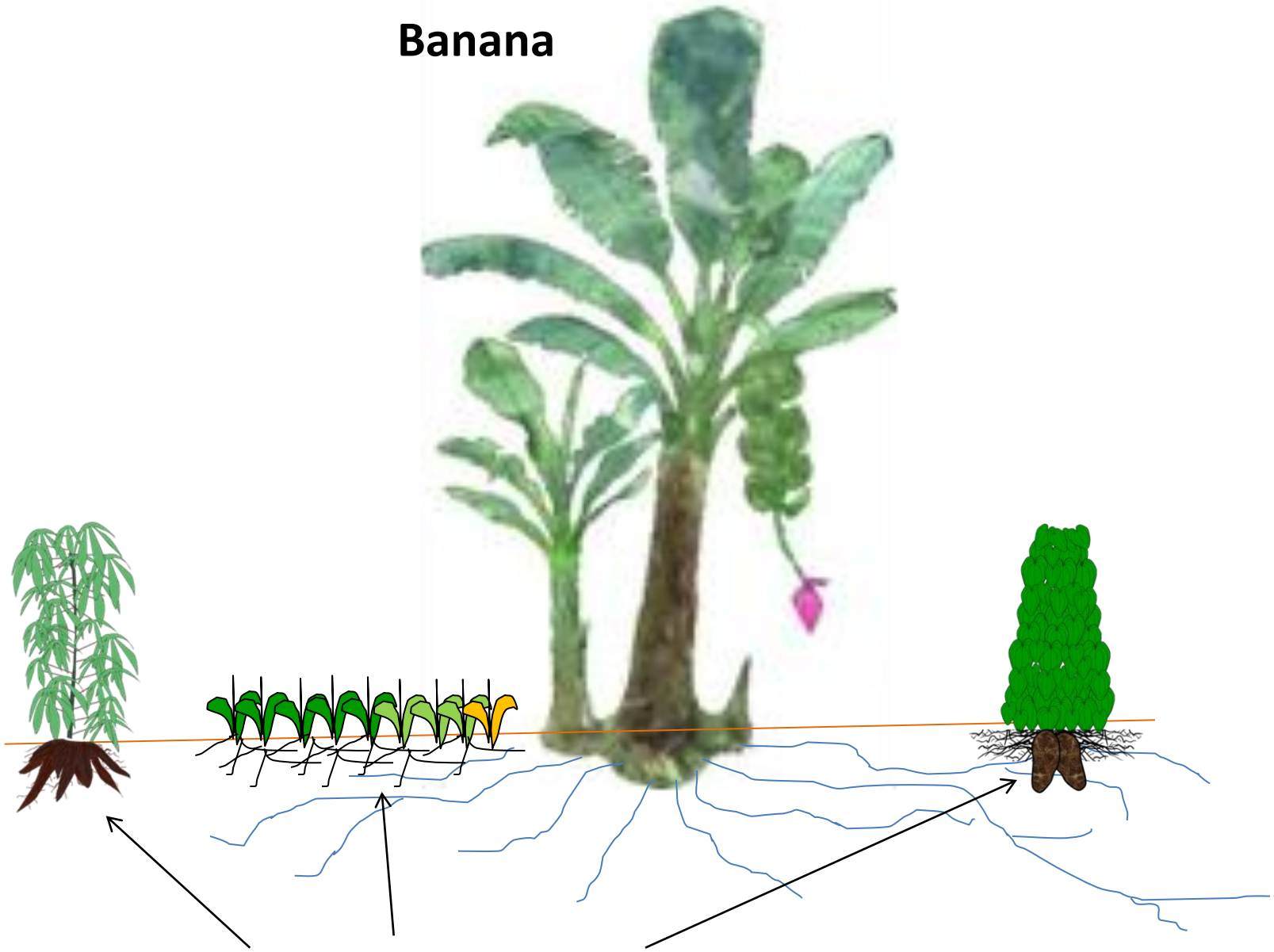
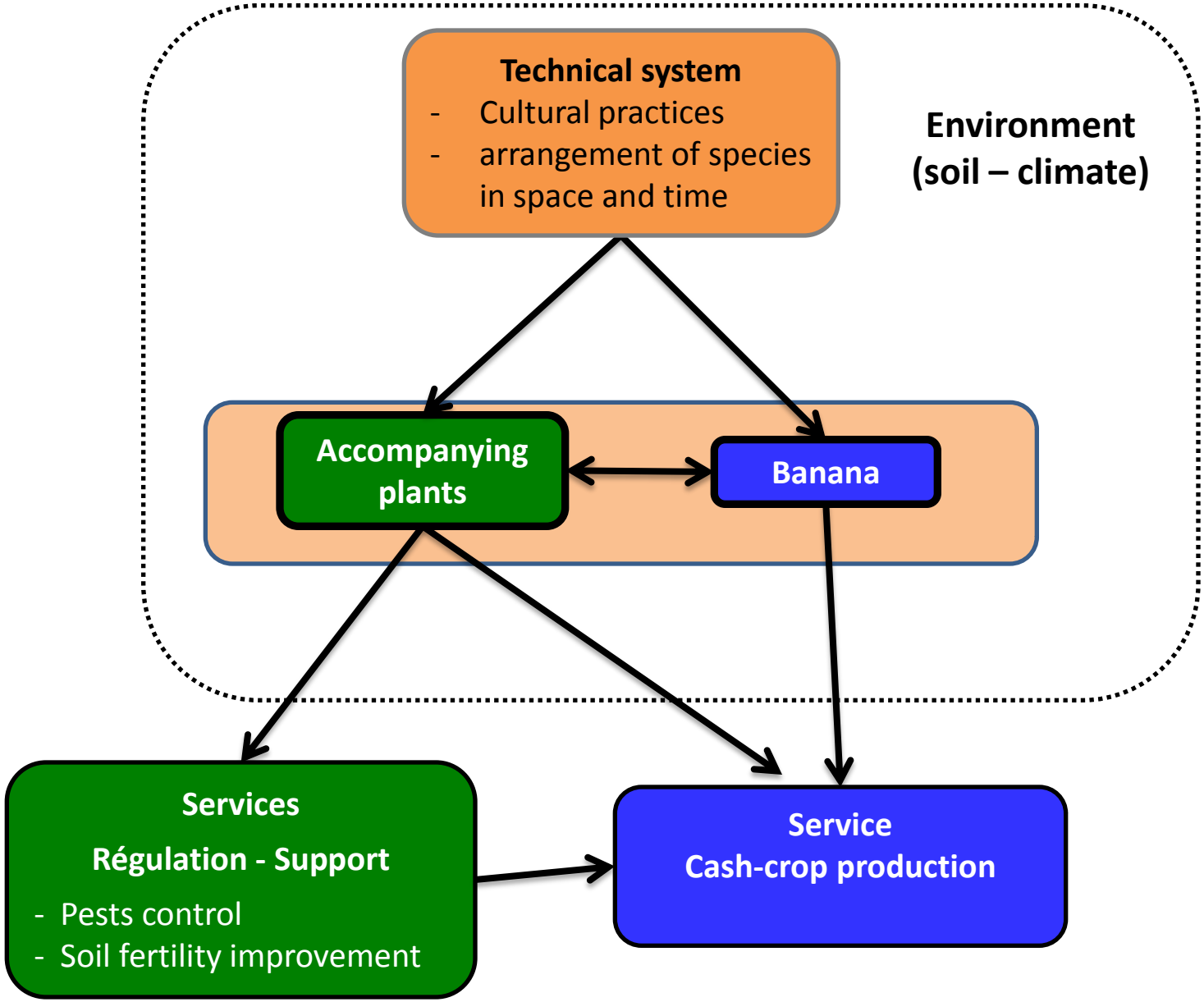
LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT



Adapted from M. Griffon 2013



Accompanying plants (food crop, cover crop, weed)



Agro-system representation

Accompanying plants can provide agro-ecological services

=> “Service plants”

Expected agro-ecological services

. **Pest control** (nematode, weevil borer,….)

. **Weed control**

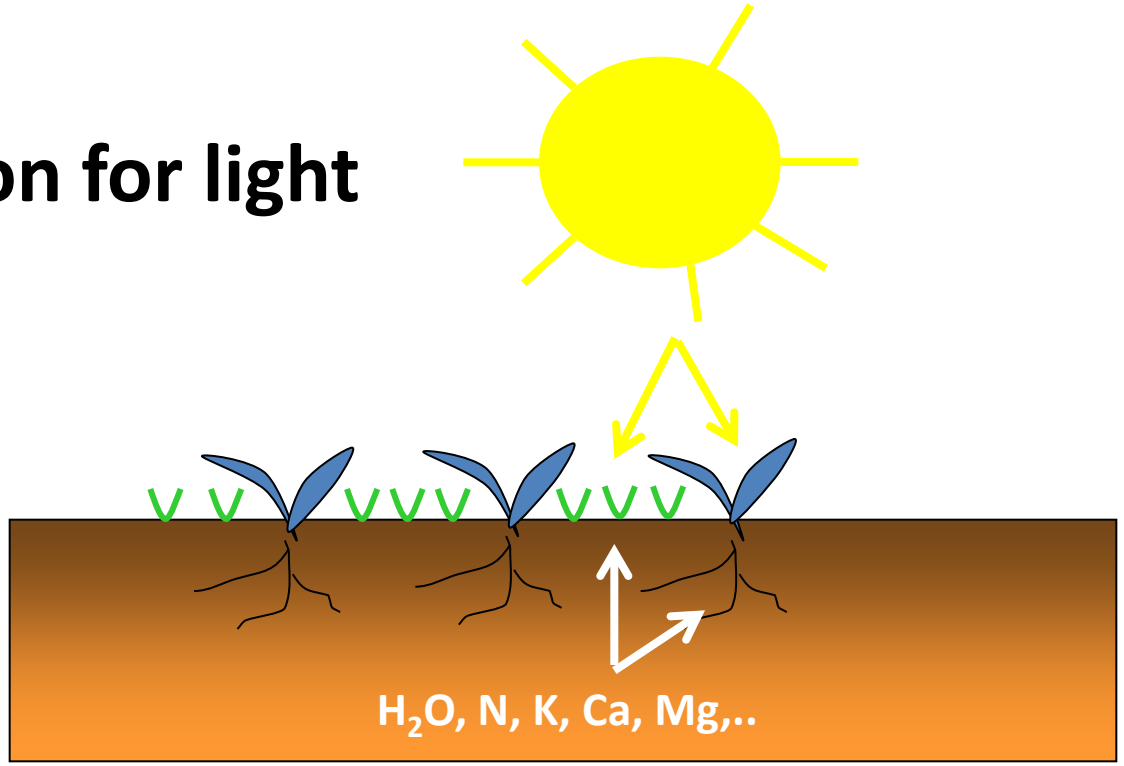
. **Soil fertility improvement**
Soil structure
Nutrients bio-availability

. **Effect on** p**roduction**
Low competitiveness with banana for resources uptake

Use of service plants for weed control

1. Installation of cover-crop competing with weeds during fallow period

Competition for light



Competition for soil resources

Highly competitive plants

. Brachiaria

Rapid covering

High root density and biomass

. Pueraria, Neonotonia, Mucuna

Rapid covering

climbing habit

These plants also compete with banana

=> Use only during fallow period

Use of service plants for weed control

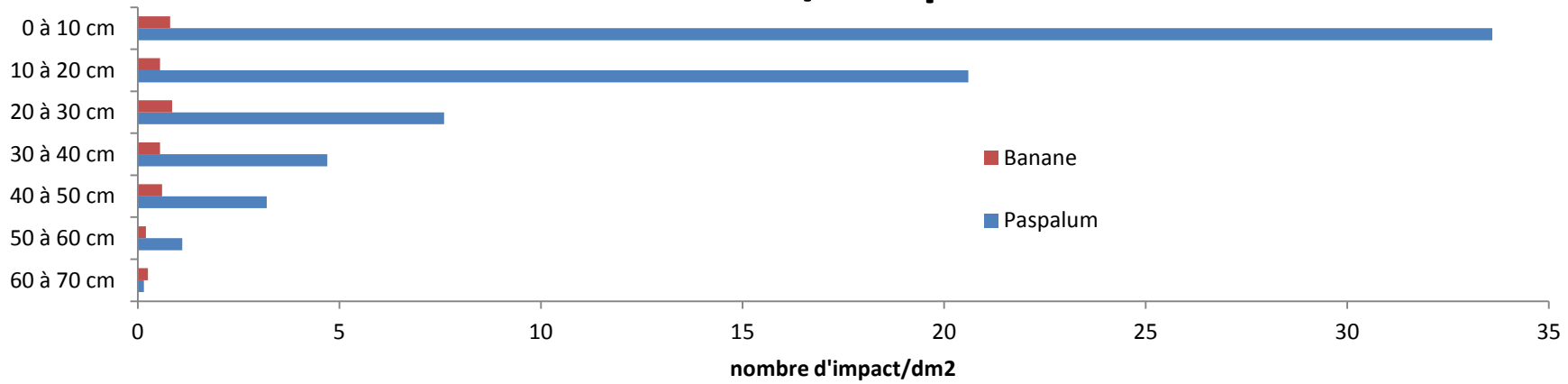
2. Installation of cover-crop under banana canopy

. **<u>Cover-crop competing with weeds but not with banana</u>**

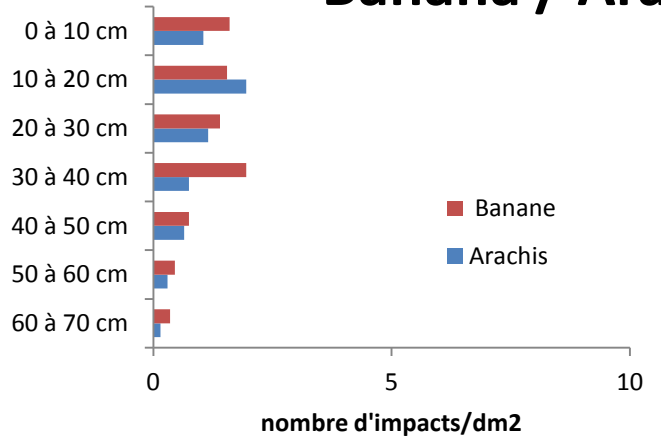
Low size or creeping plant
Low root density

Root density

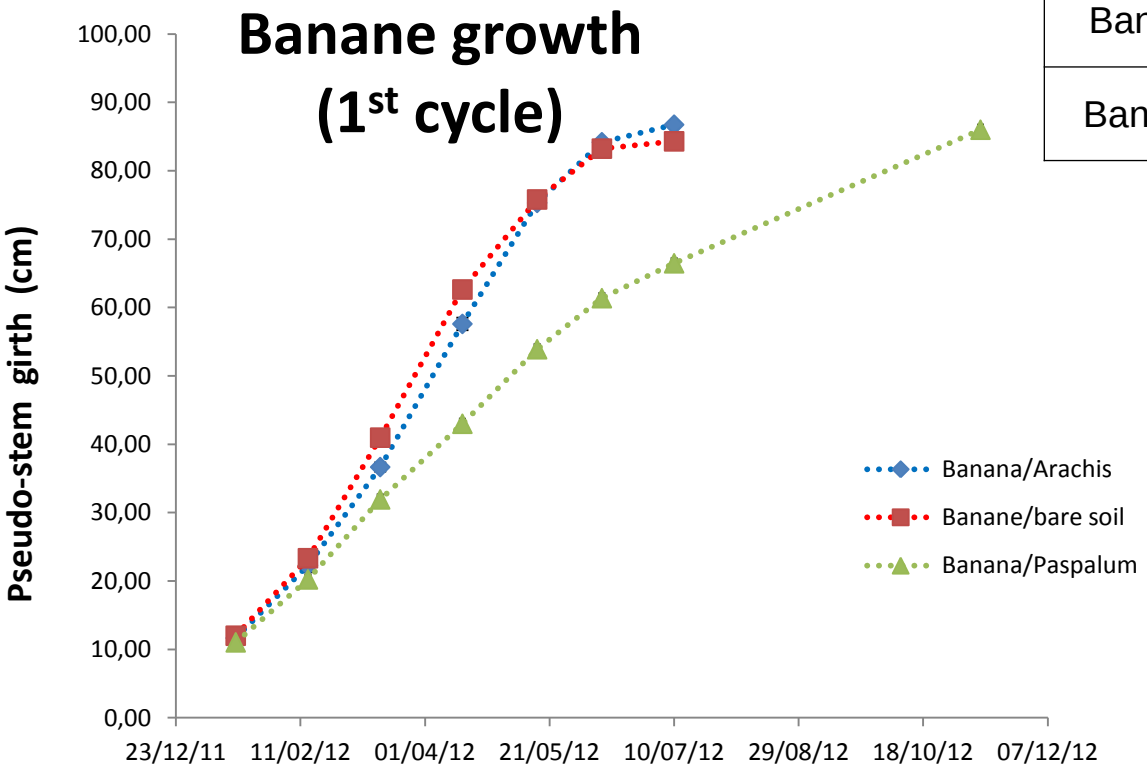
Banana / Paspalum



Banana / Arachis



Banana/cover-crop competition

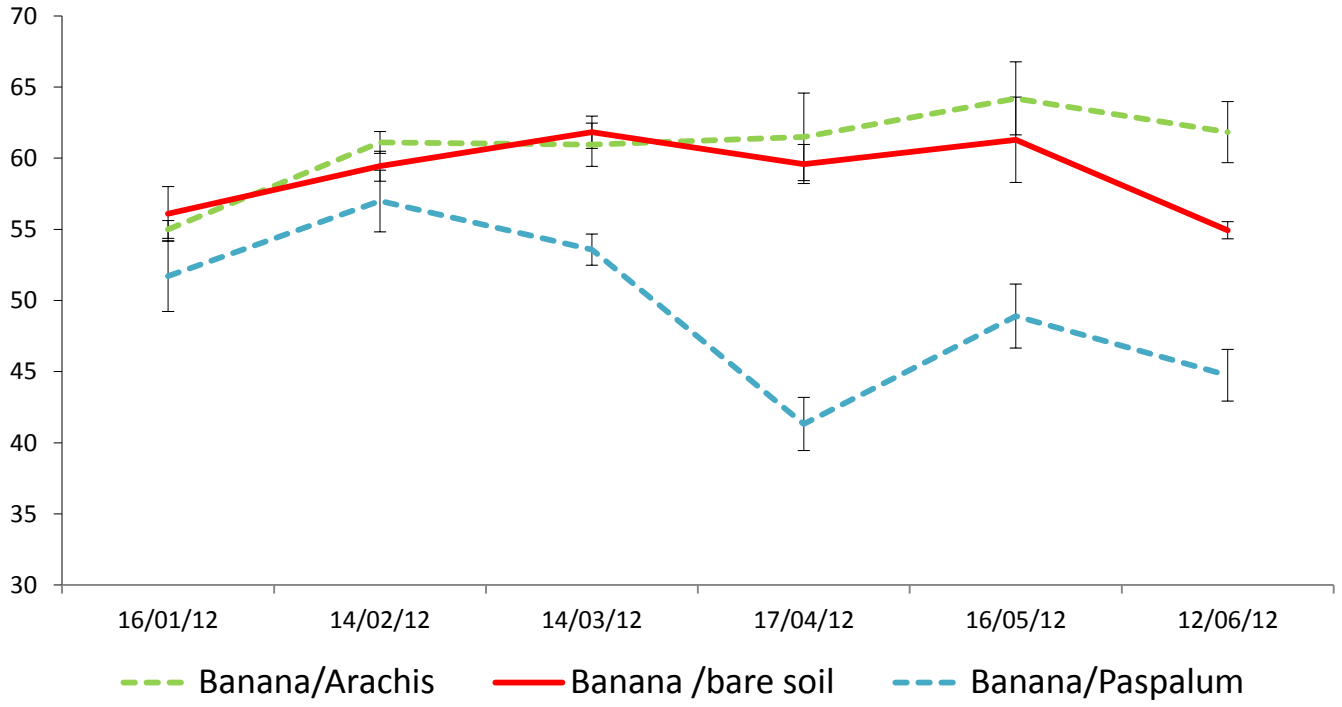


	Bunch fruits number	
Banana/ Arachis	189	A
Banana /Bare soil	172	AB
Banana/Paspalum	143	B

Banana nitrogen nutrition indicator

(SPAD chlorophyll-meter)

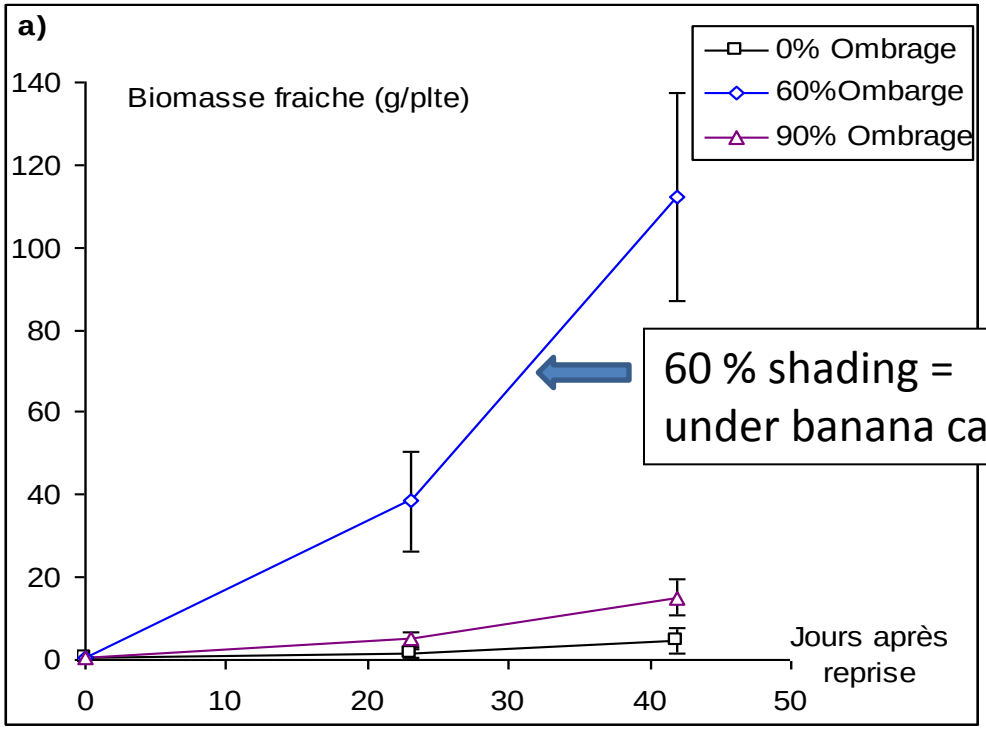
1st cycle



. Shade tolerance

=> Plants with optimal growth at low light intensity

Effect of shading on Impatiens growth

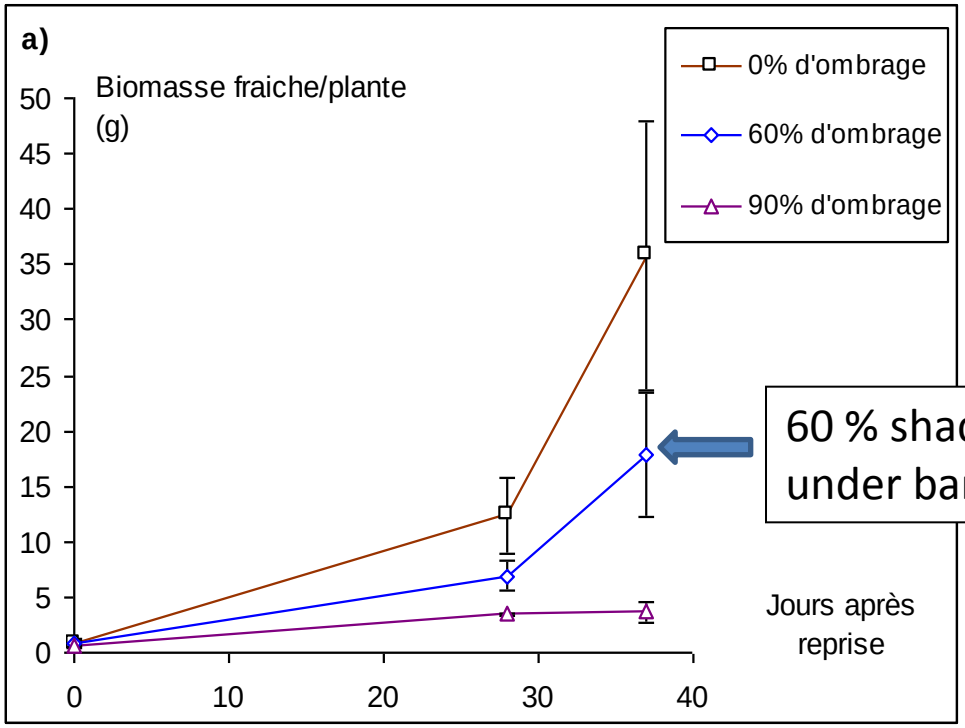


60 % shading =
under banana canopy light intensity

Shade tolerance

=> Adaptability to low light intensity

Effect of shading on Arachis Pintoï growth



60 % shading =
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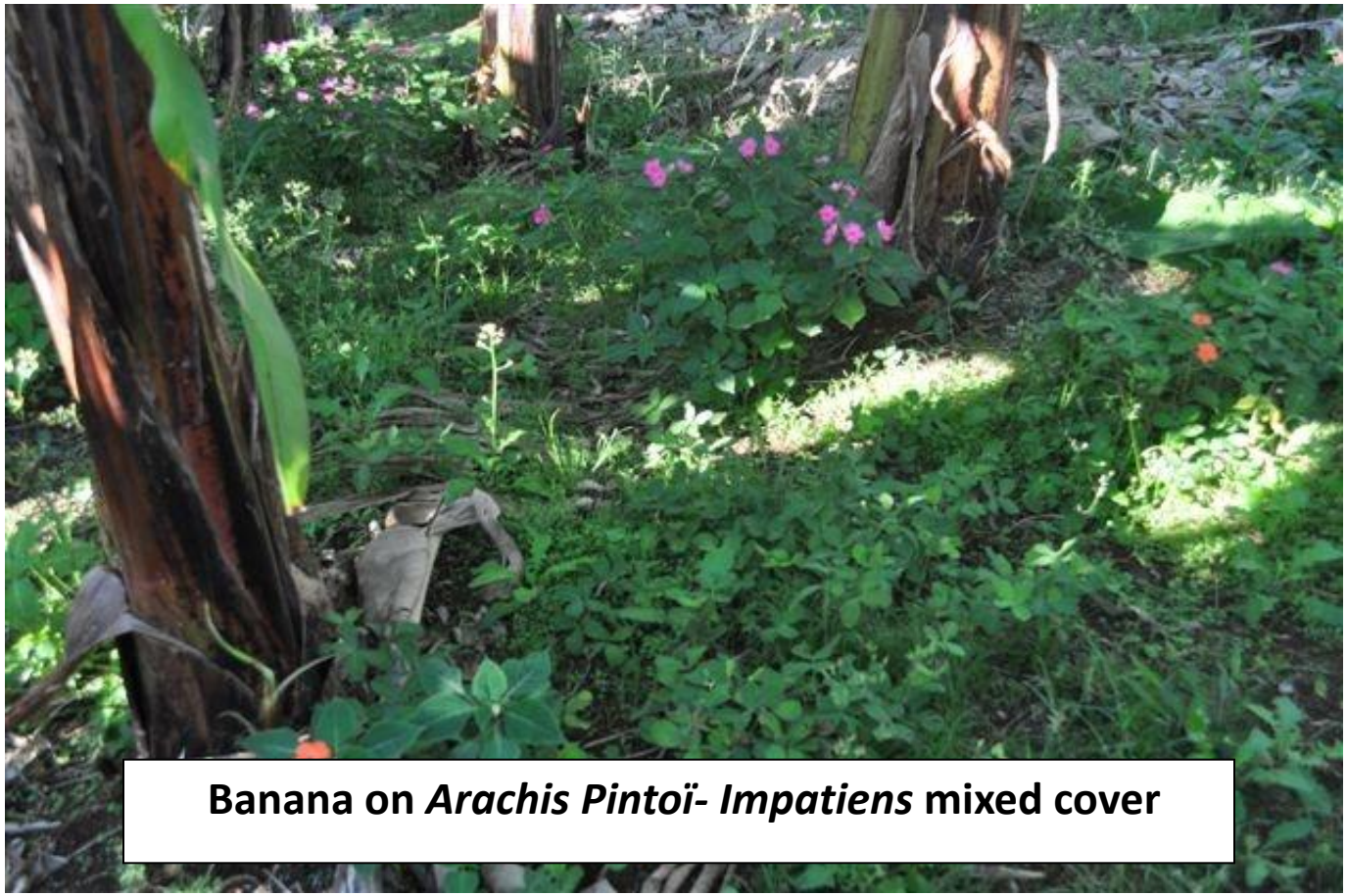


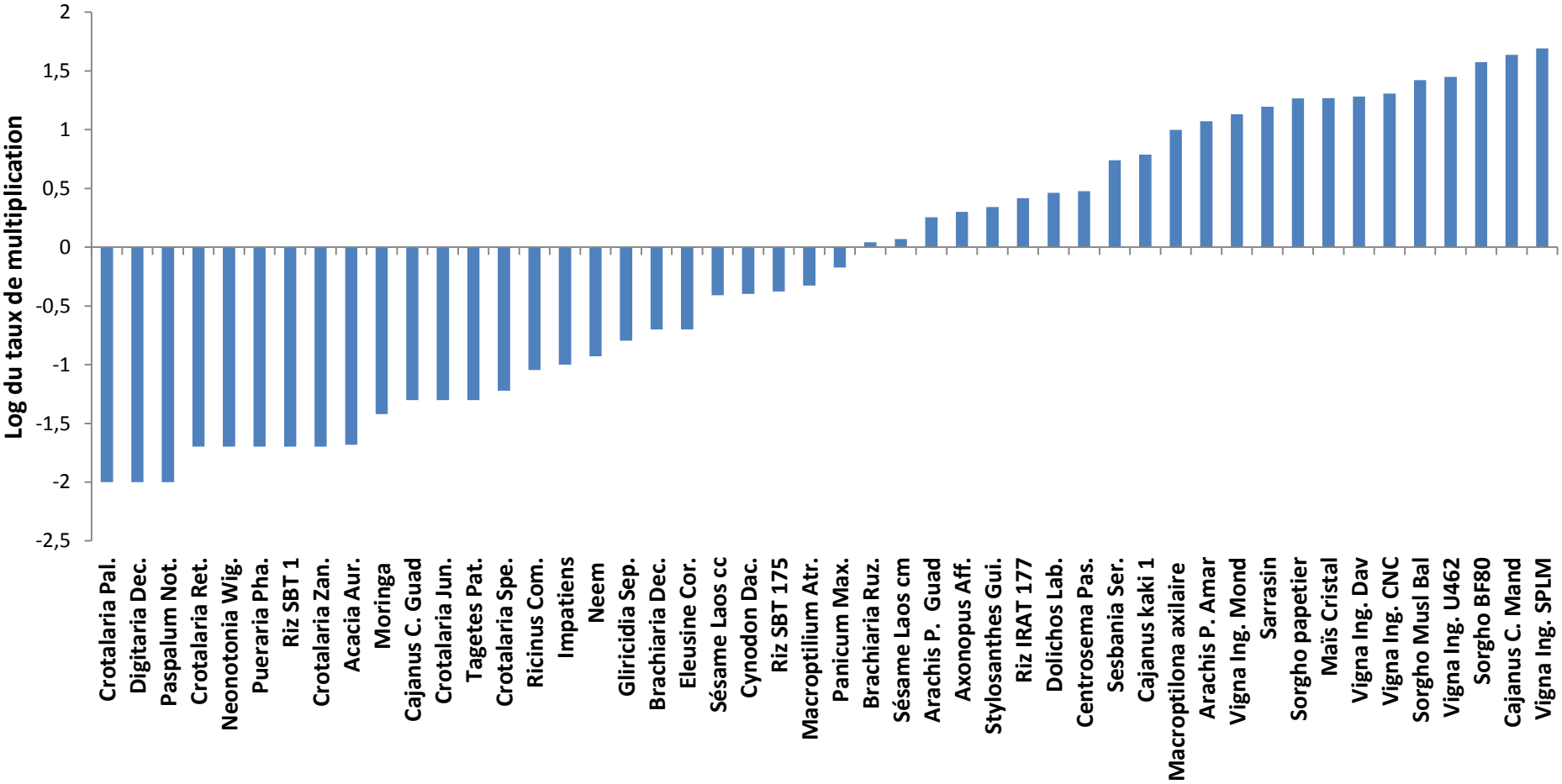
Banana on *Arachis Pintoï- Impatiens* mixed cover

Use of service plants for plant-parasitic nematodes regulation

1. Sanitation during fallow period

Installation of cover-crop non-host of banana nematodes

Multiplication rate of nematodes (*Radopholus Similis)* by cover-crops



Crotalaria cover during fallow period

2. Planting with nematode-free material

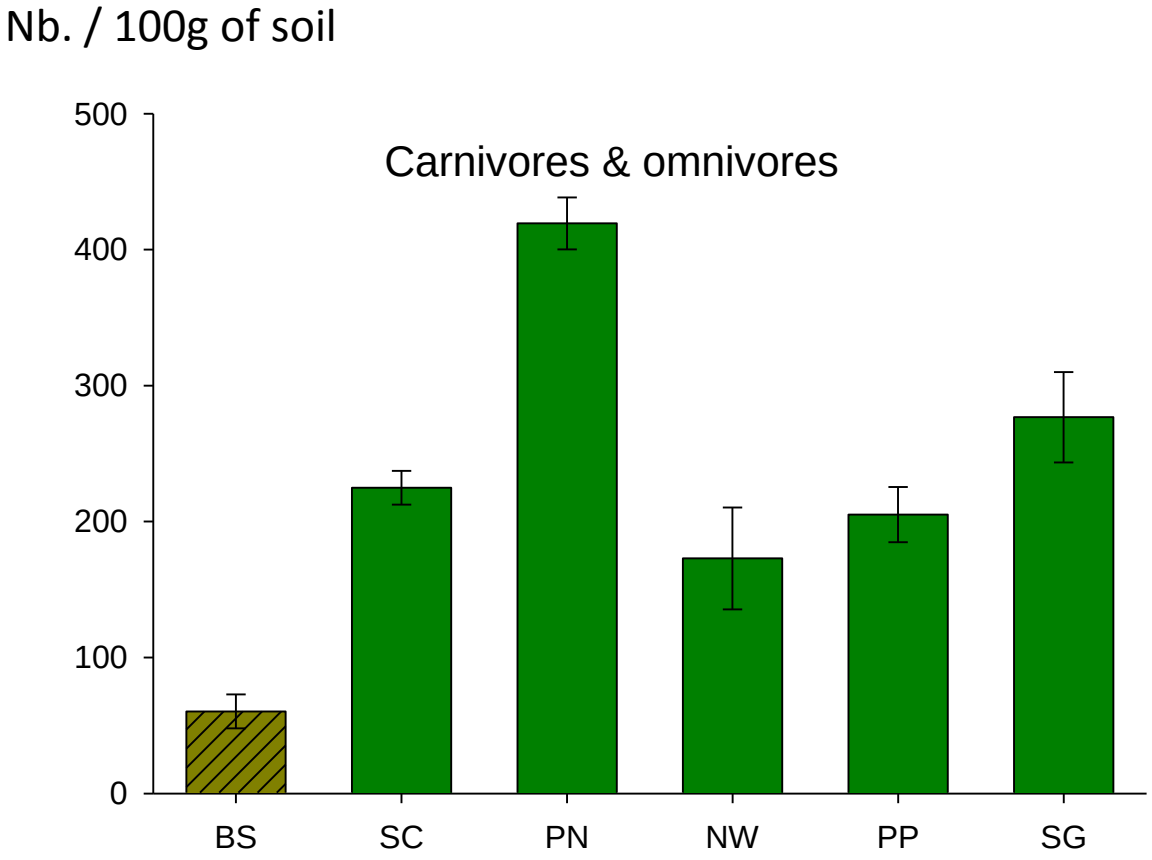
Nematode-free plants on nematode-free soil

3. Favoring nematodes predation

Comparison of free-living soil nematodes communities in :

- Bare soil
- Soil under cover-crops

BS: Bare Soil
SC: Spontaneous Cover
PN: *Paspalum N.*
NW: *Neonotonia W.*
PP: *Pueraria P.*
SG: *Stylosanthes G.*



→ **Cover-crops increase predators populations**

Djigal et al. 2011

Effect of cover-crops on weevil-borer control

CINHP / G. McCormack

Cosmopolites sordidus

In soil litter general predators contribute to weevil borer control:

- Ants
- Earwigs…

Lycosidae

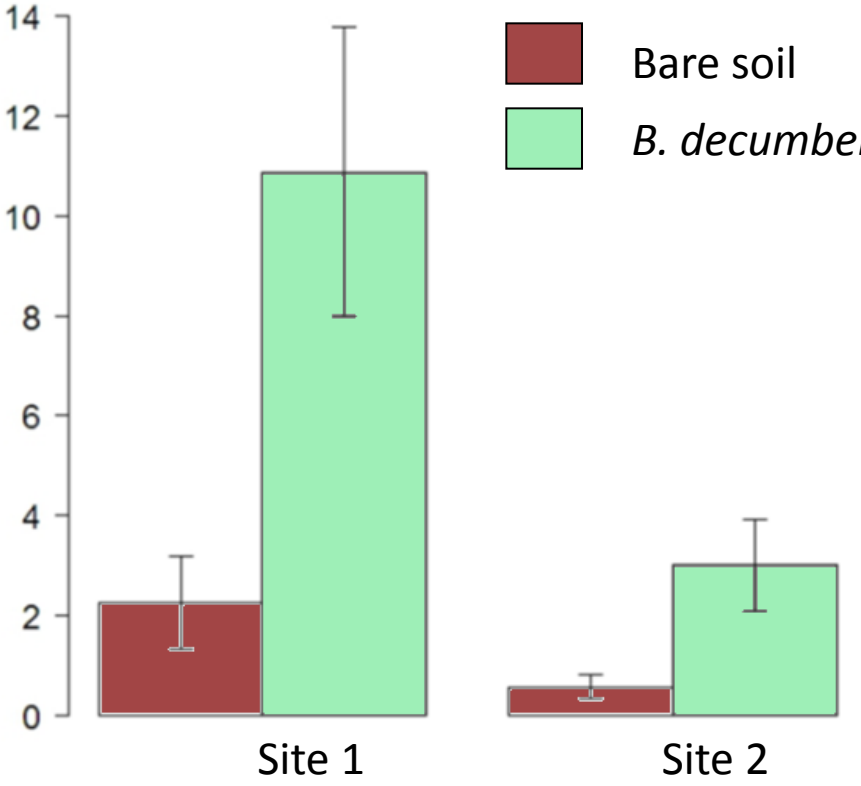
Camponotus

E. caraibea

Cover-crops increase predators abundance

Captures of ants

Solenopsis geminata



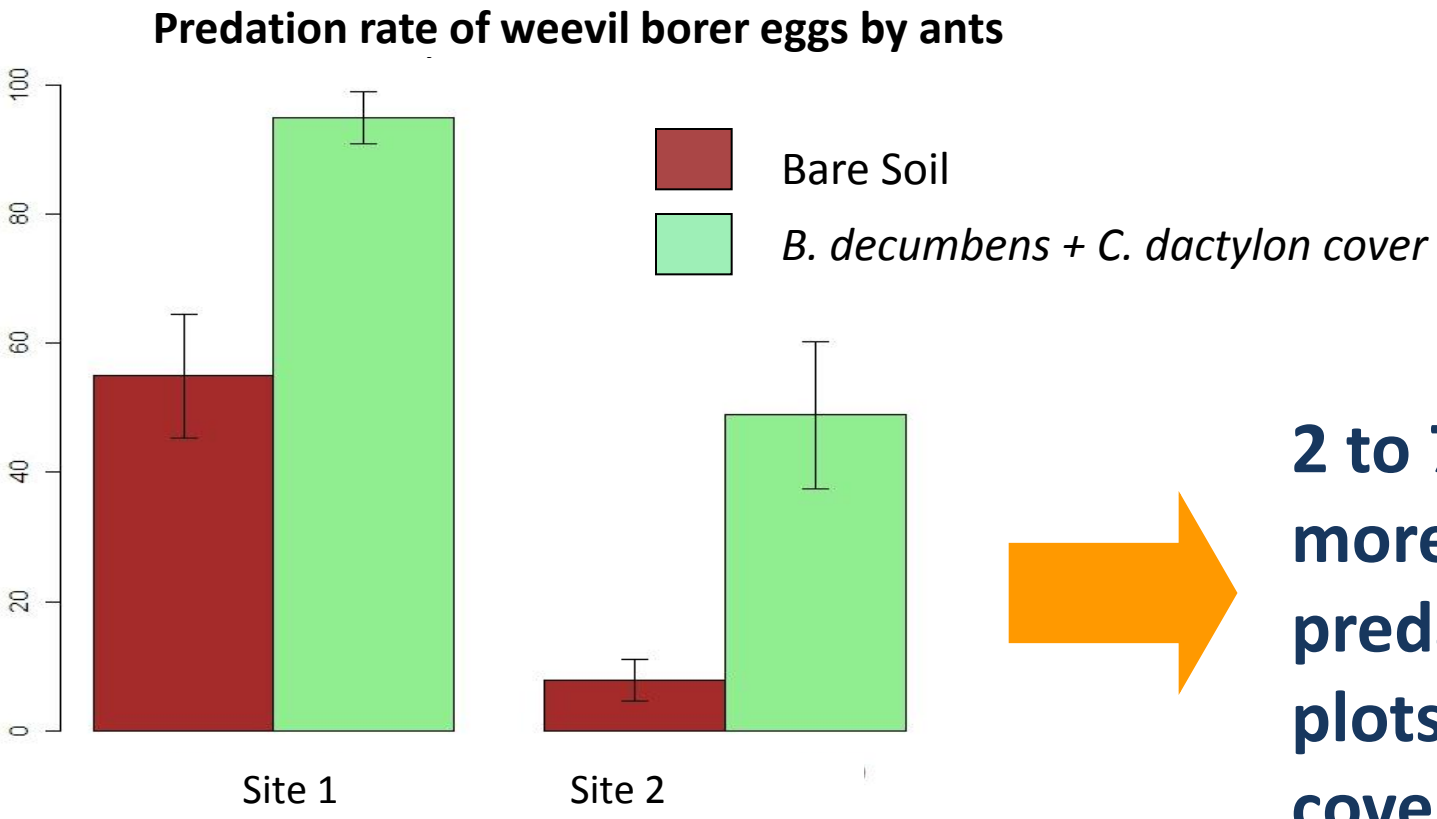
Bare soil

B. decumbens + C. dactylon cover

5 times more ants in plots with cover-crops

Mollot et al. 2012

Predators increase the predation rate of weevil borer eggs



2 to 7 times more predation in plots with cover-crops

Mollot et al. 2012

Use of service plants to improve nutrients recycling and bioavailability

Root nodules

Crotalaria:

. Atmospheric N_2 fixation
=> **Symbiosis with Rhizobium**

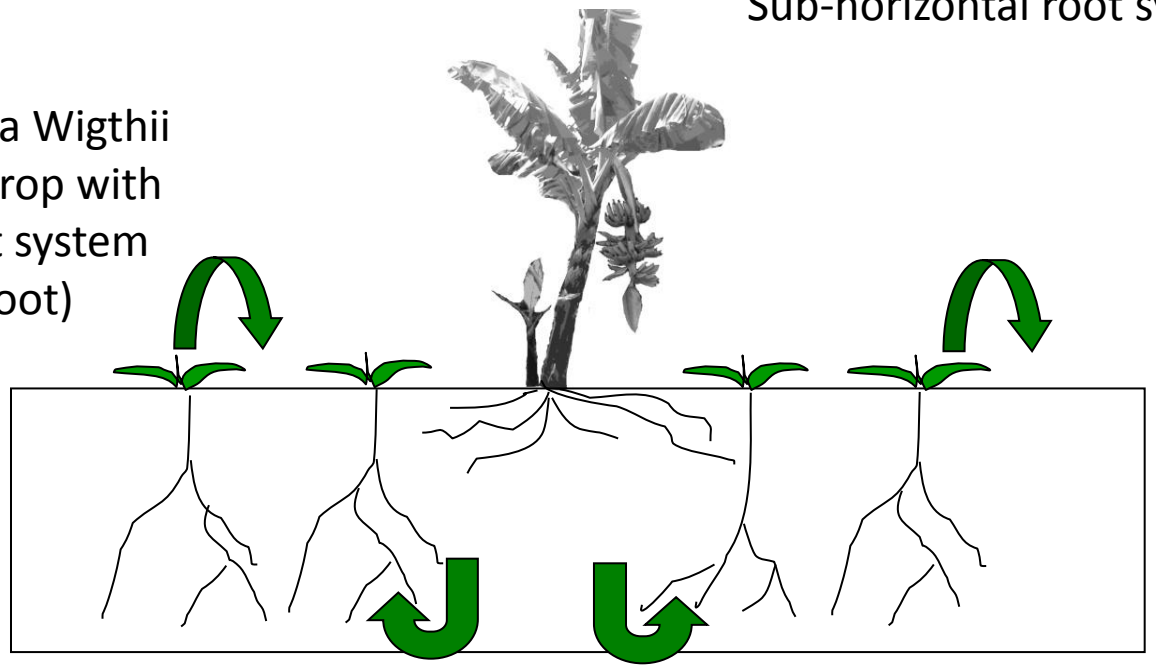
. Increase of P bioavailability
$\Rightarrow$ **Mycorrhiza**

Use of service plant to improve nutrients recycling and bioavailability

Banana

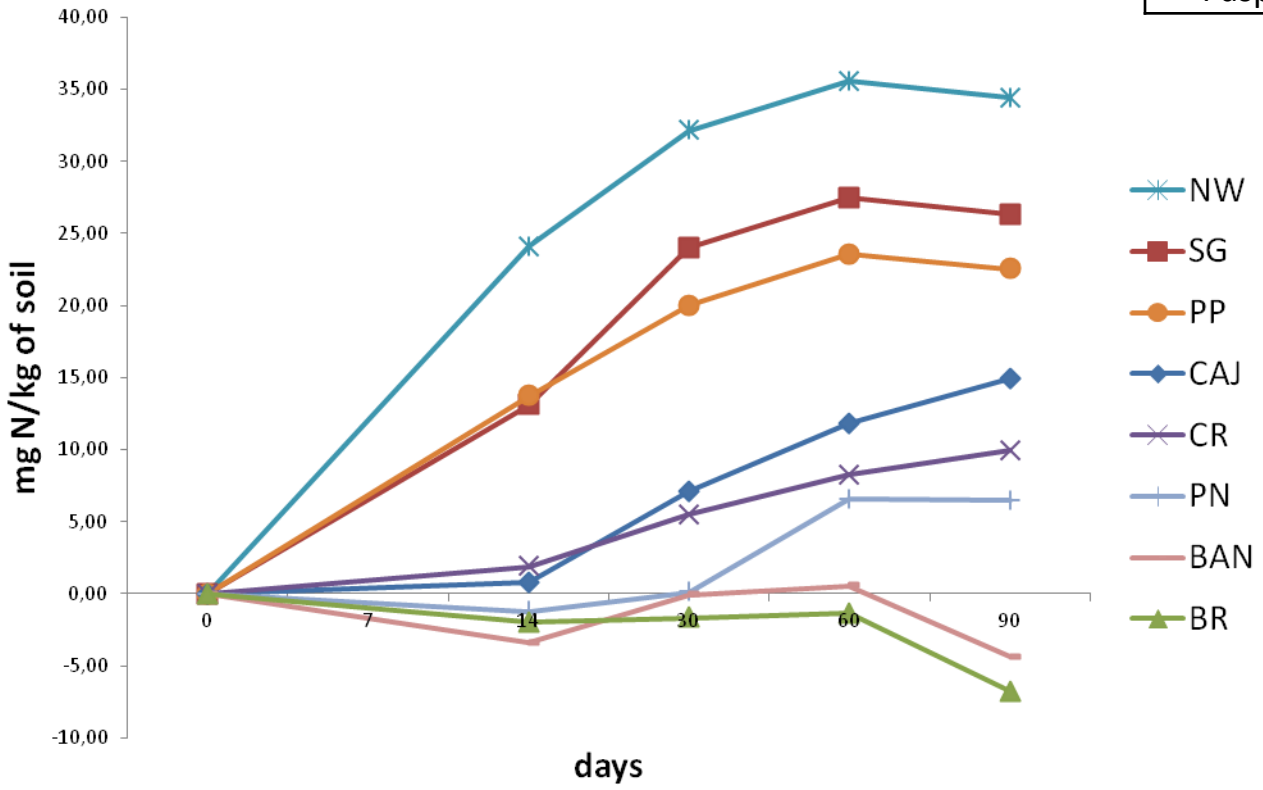
Sub-horizontal root system

Neonotonia Wigthii
=> cover-crop with
deep root system
(tap root)



C/N et mineral nitrogen release

Species	C/N
Stylosanthes G.	16
Pueraria P.	18
Banana	66
Crotalaria	29
Cajanus	23
Neonotonia W.	14
Brachiaria	90
Paspalum N.	33



Use of service plants for soil structure improvement

1. Action of roots

2. Indirect action : favoring macro-fauna (earthworms, ants, termites,…) involved in soil structure building

Brachiaria root system

Earthworms, ants, Termites

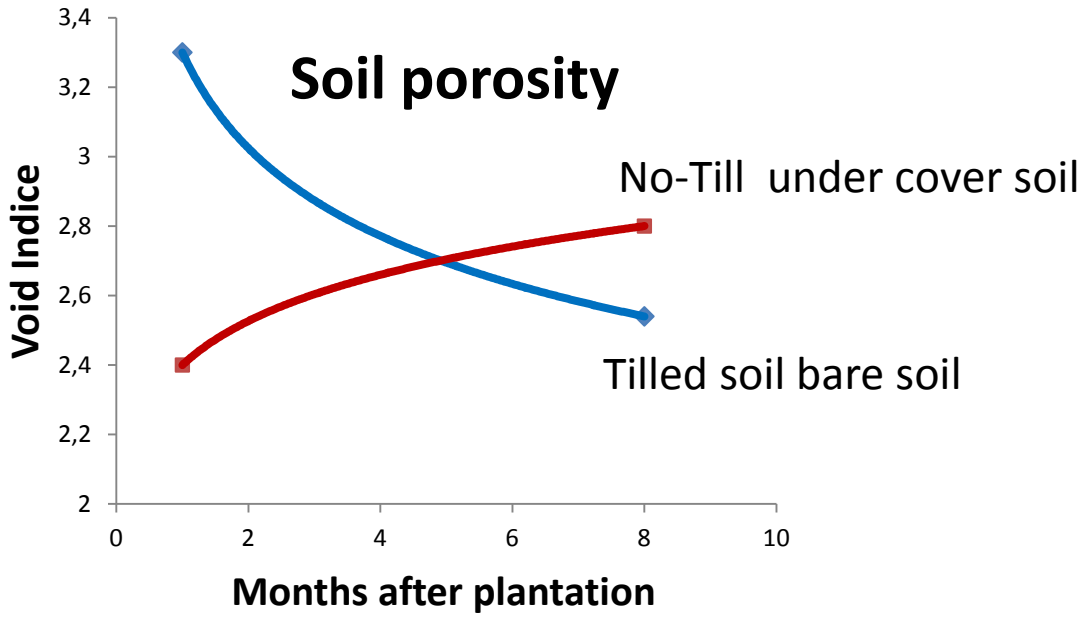
Biological prosity

. Biological soil structure

=> Tubular porosity (root path,…)

=> Aggregates created by biological activity

=> Better stability than structure created by soil tillage

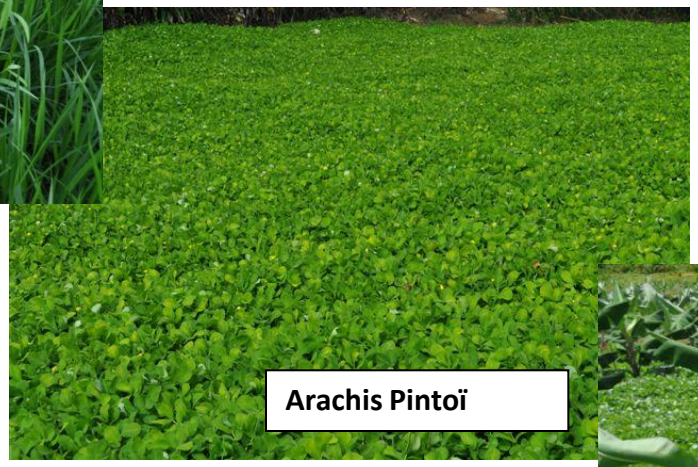


Dorel et al. 2010

Prototype of innovating cropping system

Fallow : 12 months
Soil fertility improvement
Sanitation (pest suppression)

Installation of shade tolerant cover-crop



Banana plantation on the cover -crop


Thank you for your attention